# Climate and recruitment success in *Quercus lobata* (valley oak)

Blair McLaughlin

Erika Zavaleta

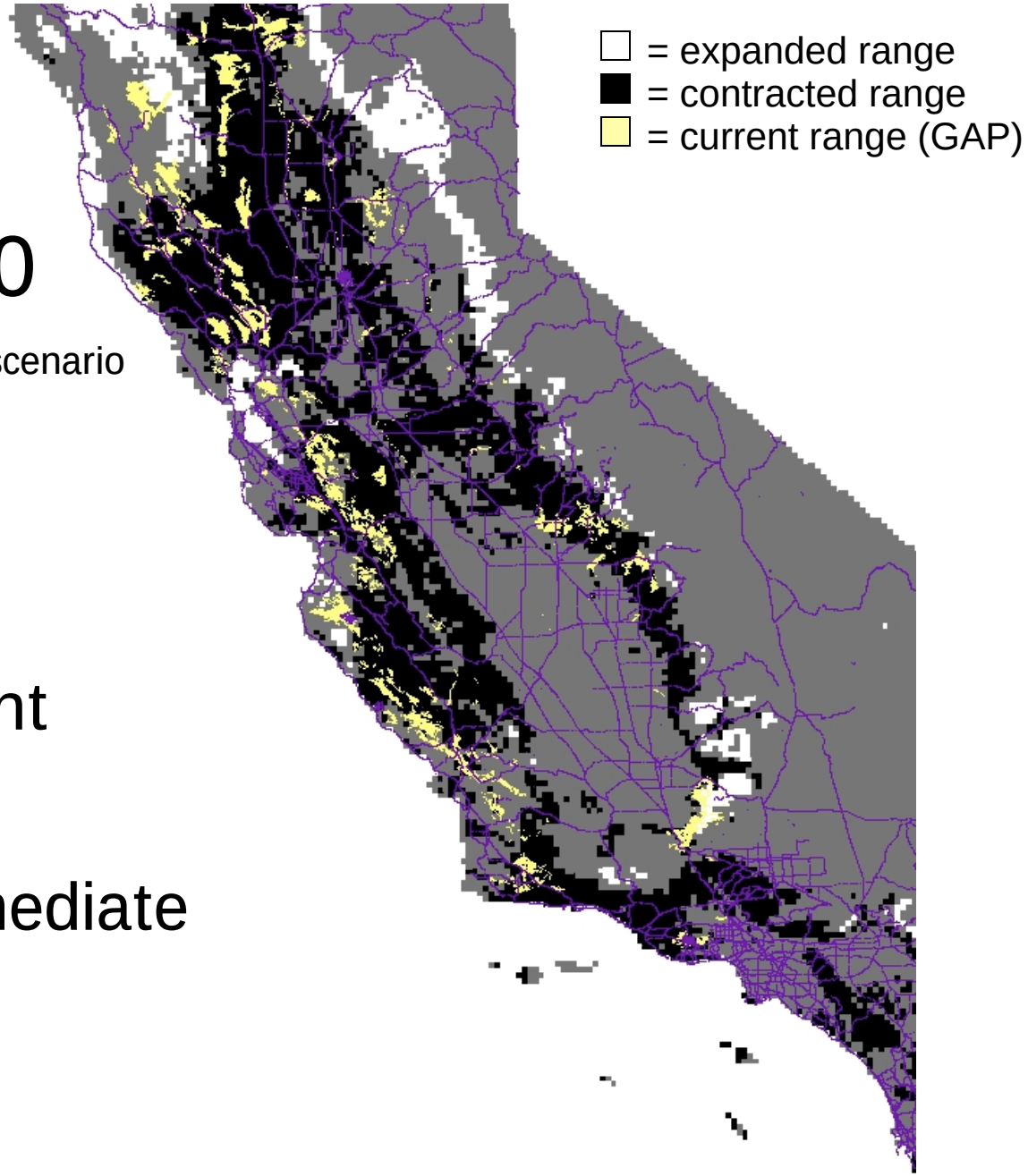
University of California at Santa Cruz

California Climate Change Symposium, September 10, 2009

# Why Valley Oak?

# Valley Oaks 2100

-RCM, Business-as-usual emissions scenario



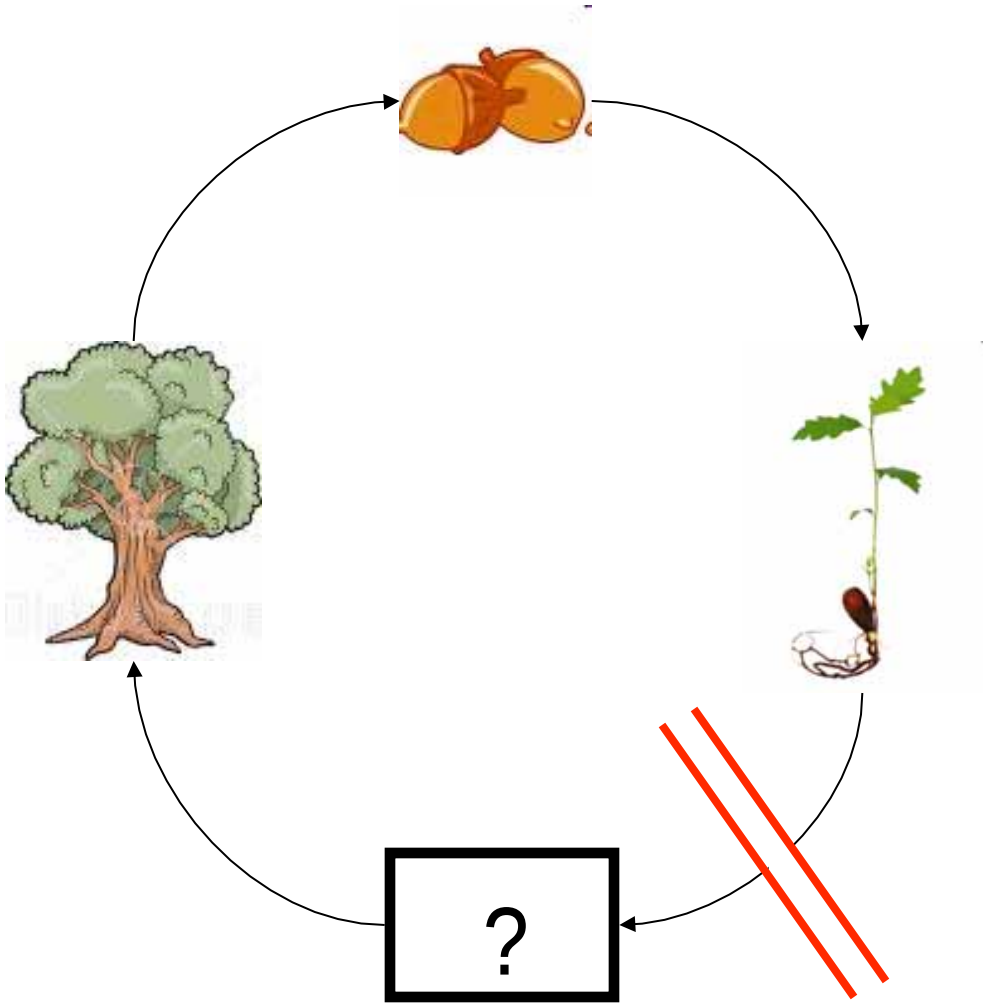

* Lose 54% of current range

* Local factors will mediate shift

Kueppers et al. 2005

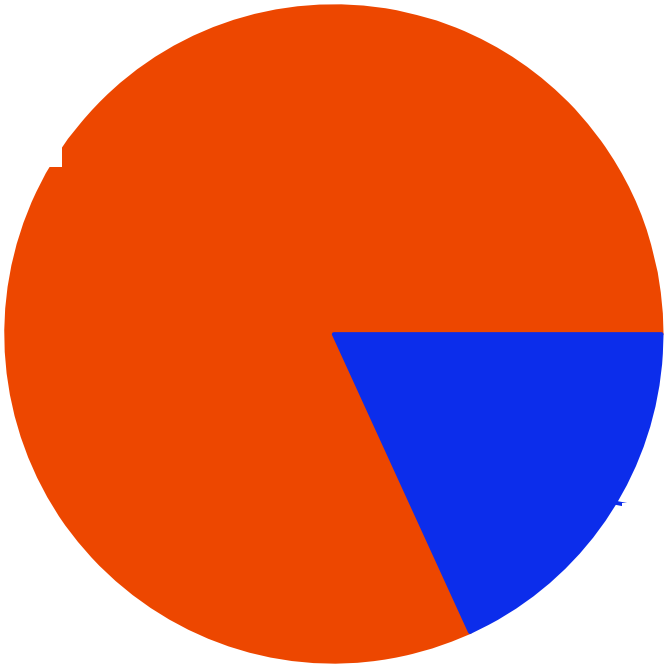
# In most previously surveyed stands valley oak seedlings did not survive to the sapling stage

(Zavaleta et al. 2007)



# Valley Oak Surveys (1976-1987)

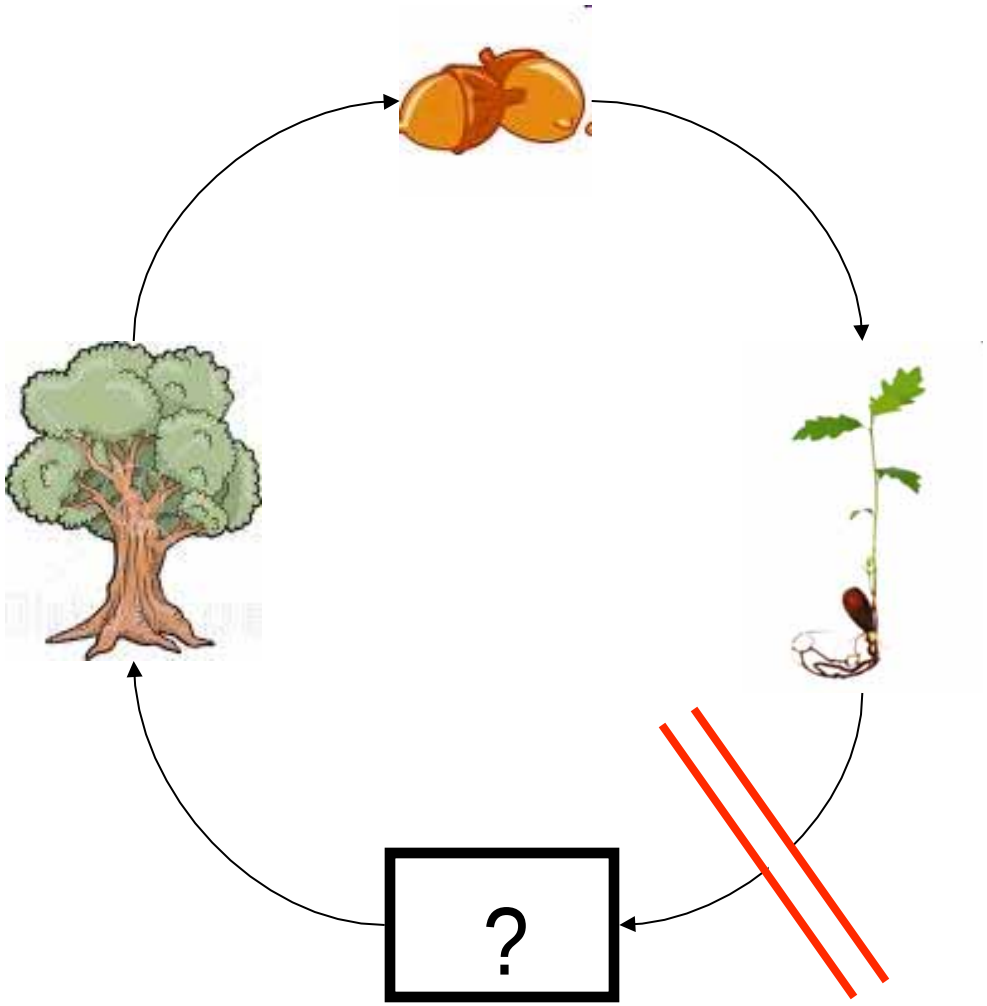
N=11



= Sites without sapling recruitment

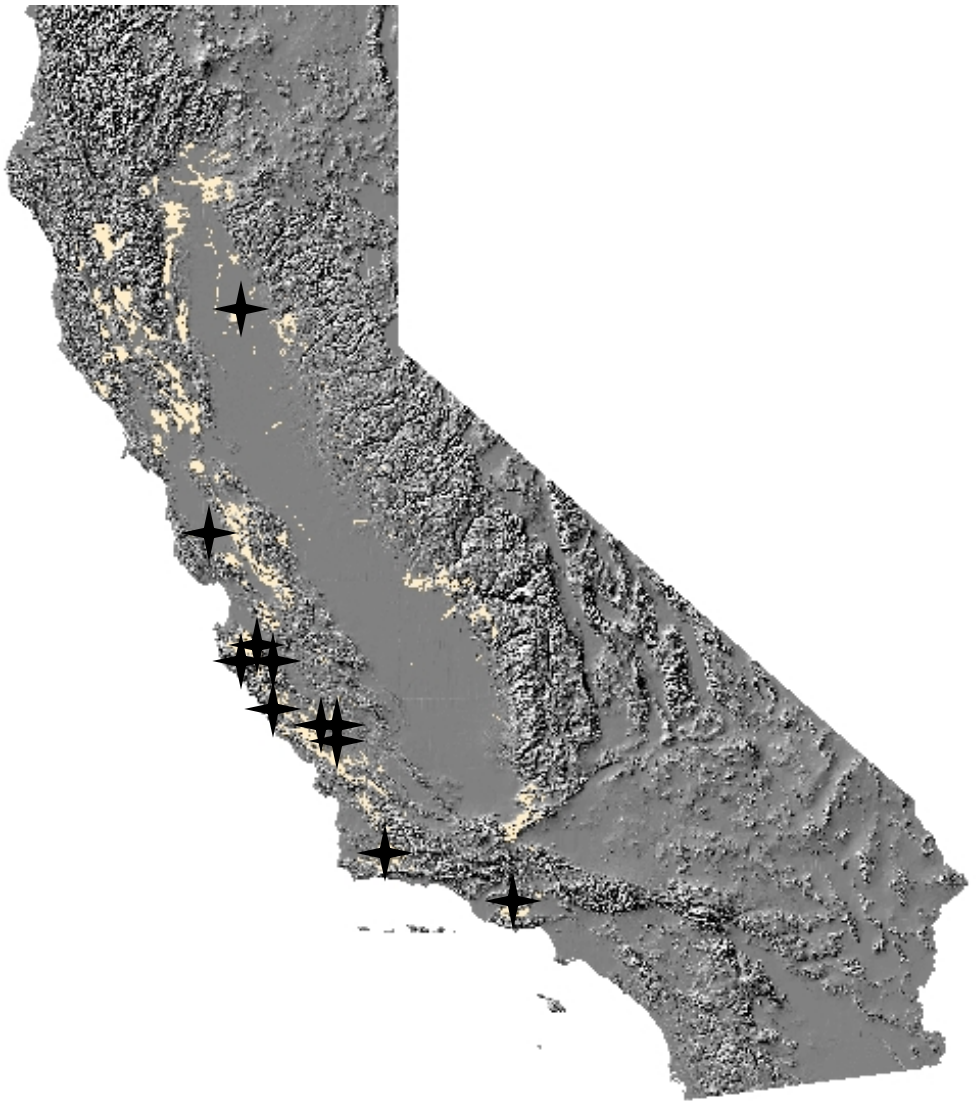
= Sites with sapling recruitment

# Individual vital rates



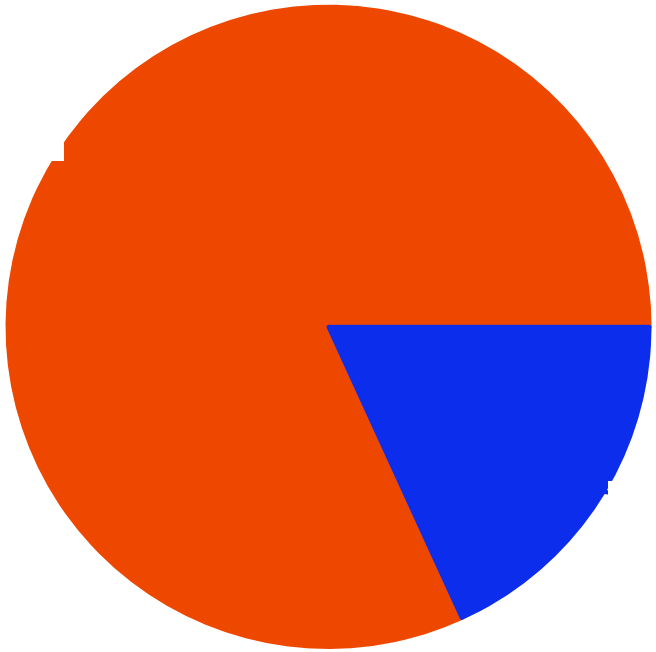

# Local interactions

# Resurvey study on previously surveyed valley oak stands

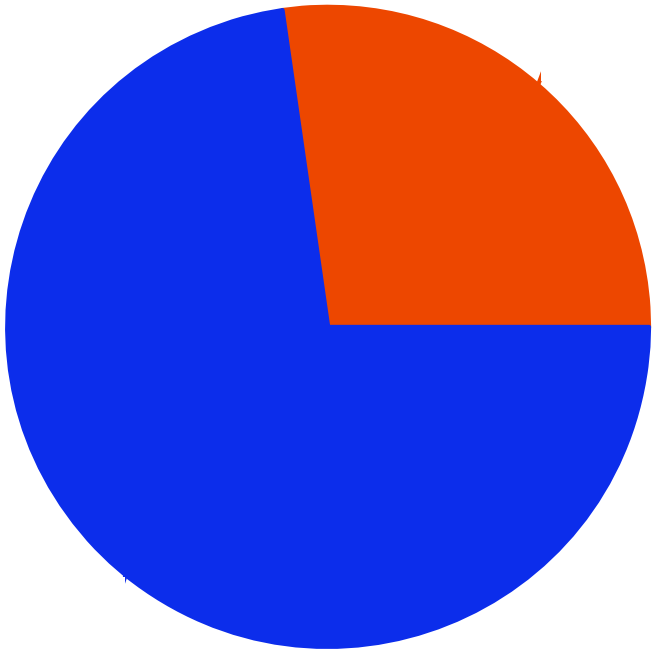


N=11

# Change in recruitment status over time
# n=11



1976-1987



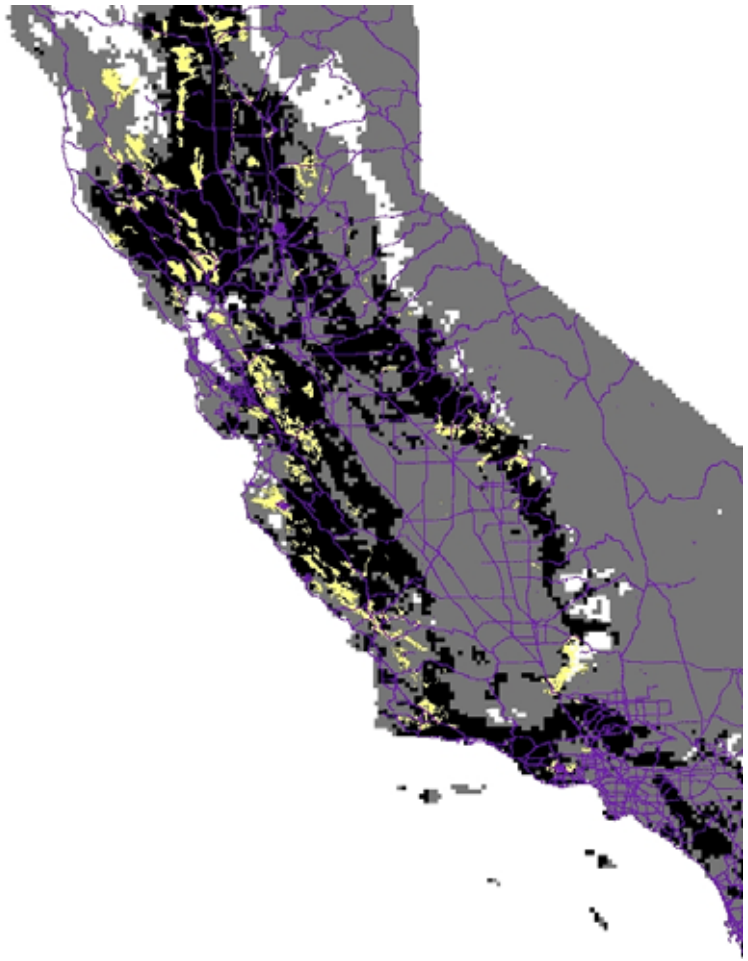
2009

P<0.01

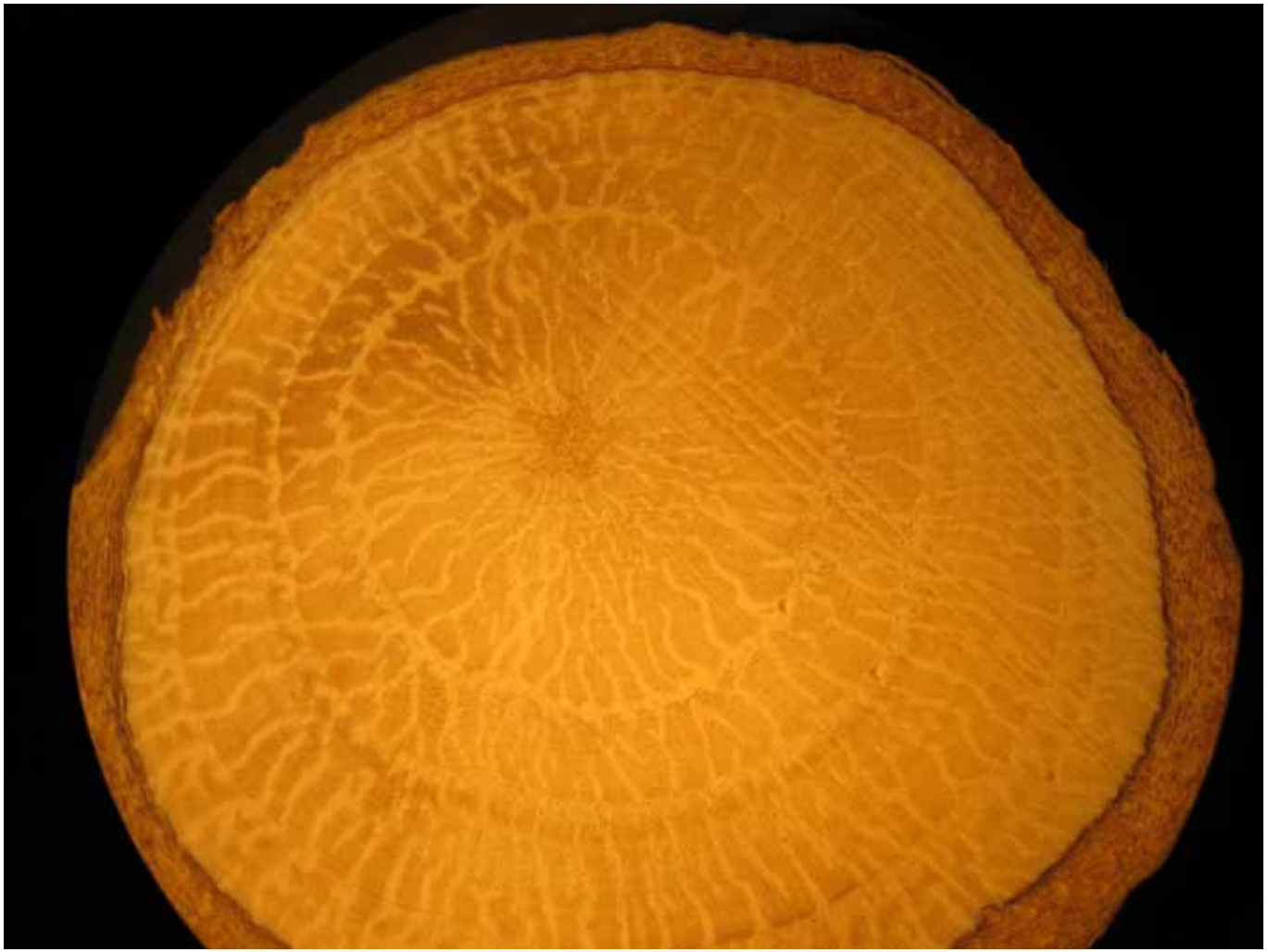
= Sites without sapling recruitment

= Sites with sapling recruitment

# Is recruitment lower in contracting areas of the range?



# Dendro Analysis



Multiple recruitment dates within sites

Cohorts not synchronized across sites

# Conclusions: Recruitment Status?

- More recruitment in recent surveys than in 1976-1987 surveys
- Saplings highly clustered around water
- Climate may not be primary influence on sapling recruitment

# Where are Valley Oaks Recruiting?

- What environmental factors are associated with successful recruitment to the *sapling* stage?

- How might drivers shift across a climatic gradient?

# Meta-Analysis of Valley Oak Planting Experiments

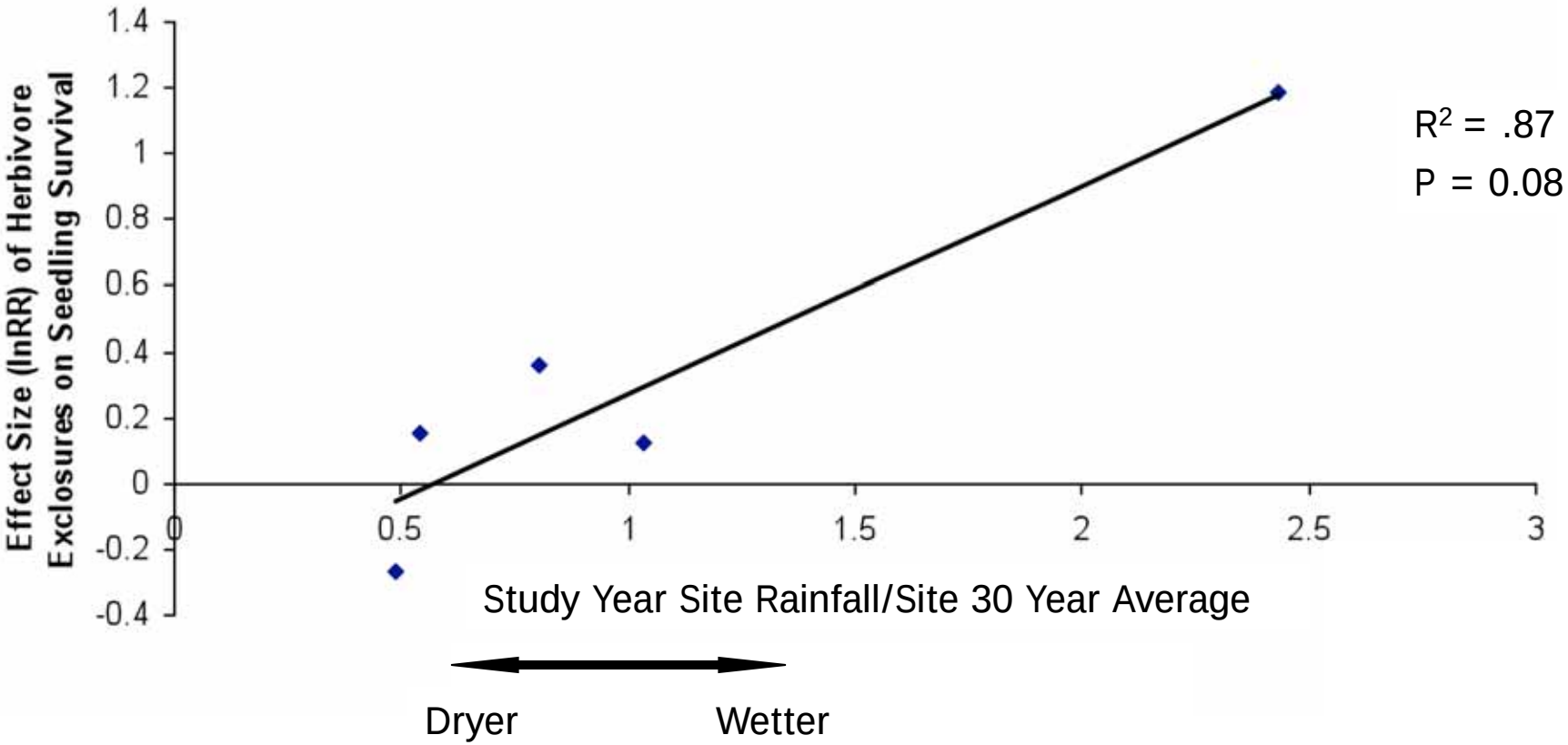
N=26

Herbivory **-**

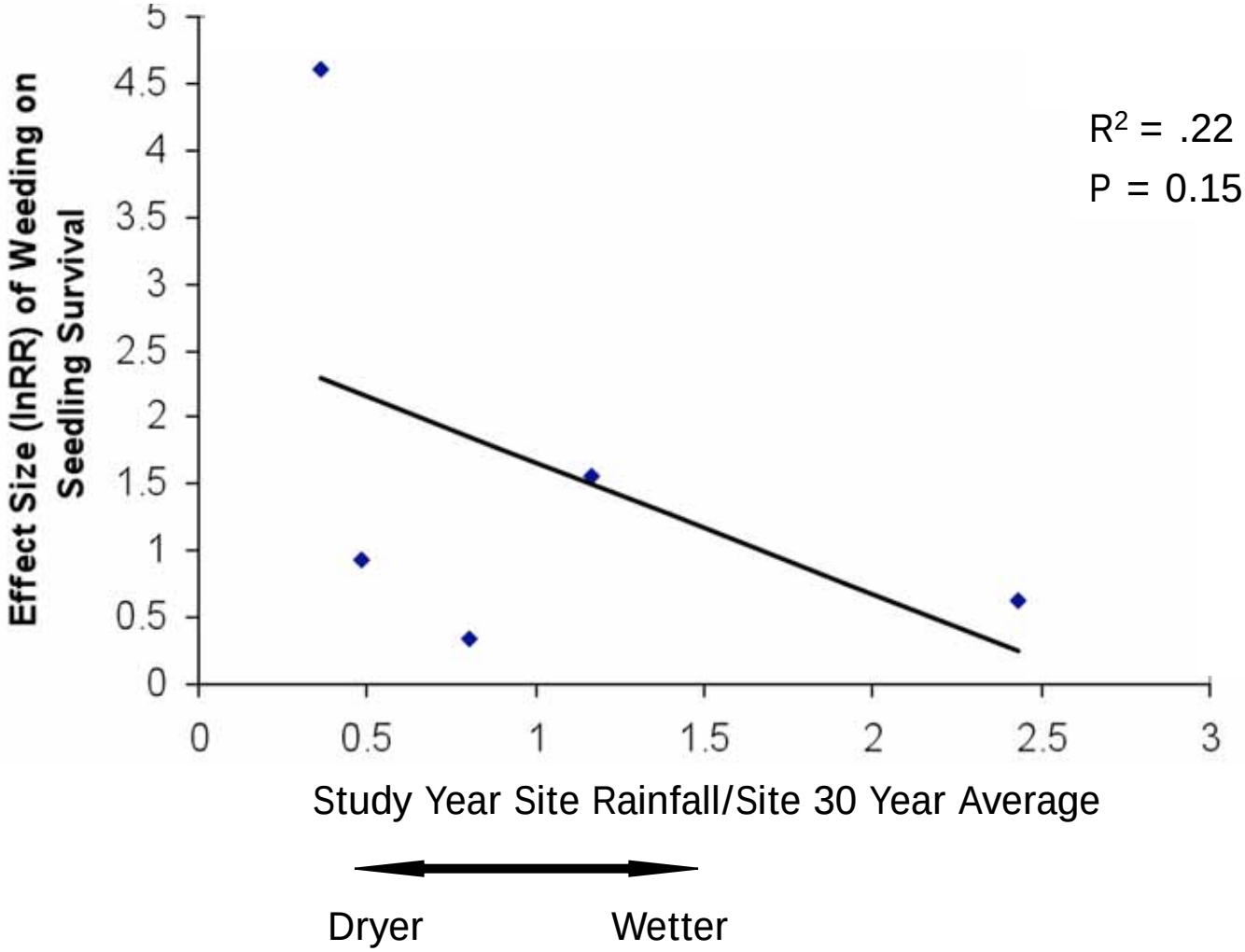
Herb Competition **-**

Watering **+**

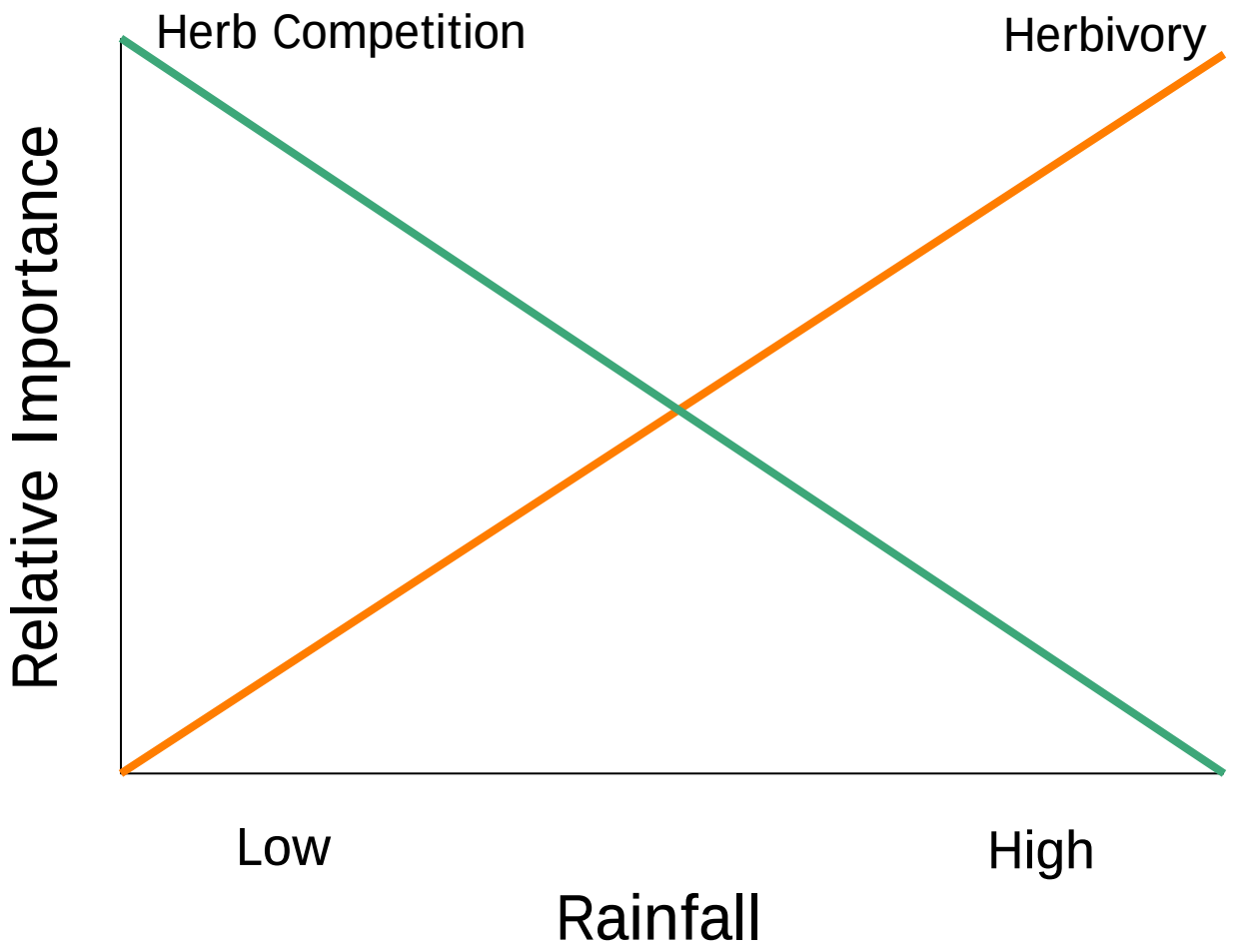
# The effect of herbivores increases with precipitation



# The effect of weeding decreases with precipitation



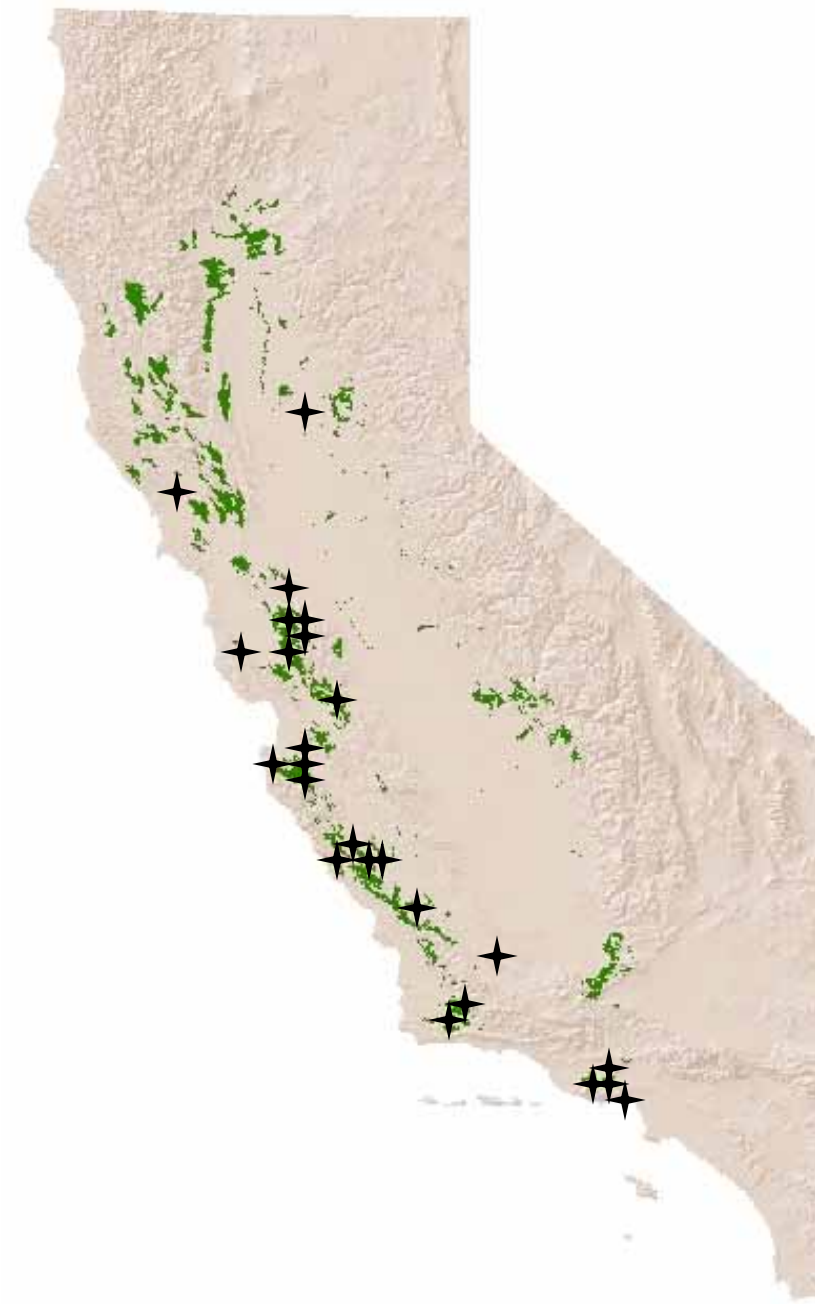
# Climate shifts importance of biological factors



# How do herbivory and herb competition interact with climate and grazing?

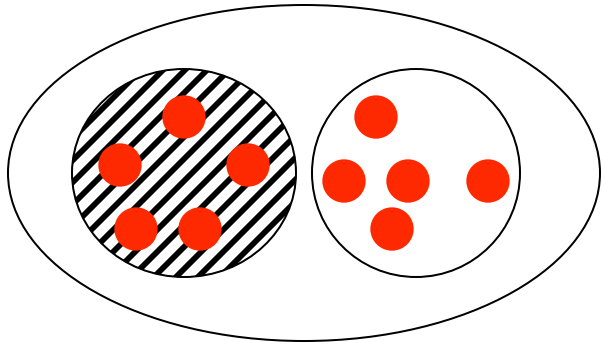
- >250 inquiries with land managers, ranchers, and conservationists to locate recruiting sites

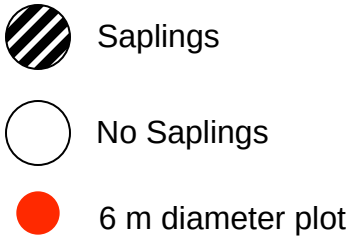
- Found 25 recruiting sites



| | Site | Savanna | Woodland |
|---|---|---|---|
| **All Within-Site Analysis** | **15** | **11** | **4** |
| **Grazed** | **7** | **3** | **4** |
| **Un-grazed** | **8** | **8** | **0** |

# Design



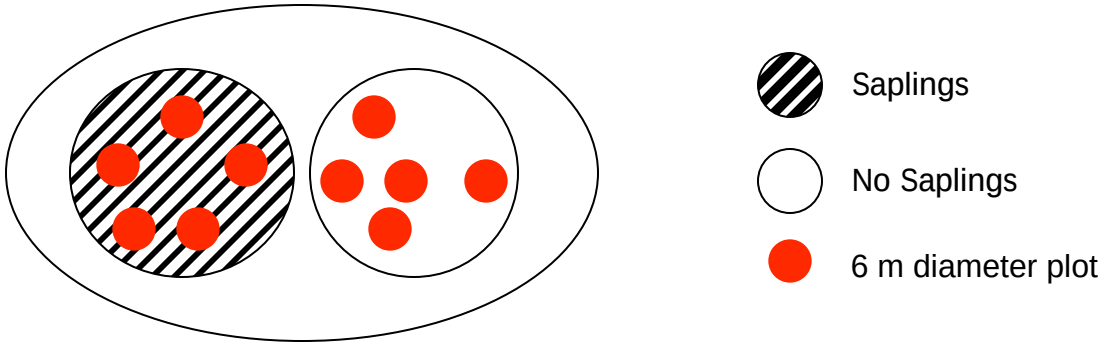


Plot Design

- Located randomly within recruiting and non-recruiting areas

- Controlled for valley oak adult cover

# Design



Plot Design

- Located randomly within recruiting and non-recruiting areas

- Controlled for valley oak adult cover

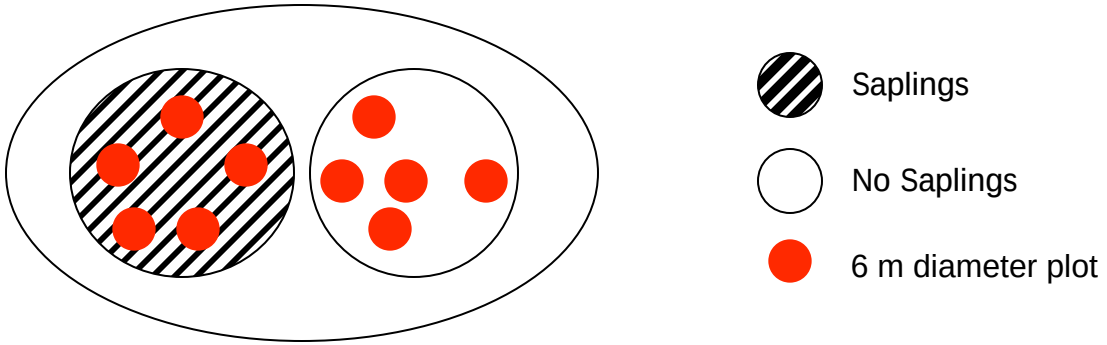
Sampled

- Herbaceous Cover

- Small Mammal Activity
*Thomomys* spp.
*Spermophilus beecheyi*

- Soil Moisture

# Design



Plot Design

- Located randomly within recruiting and non-recruiting areas

- Controlled for valley oak adult cover

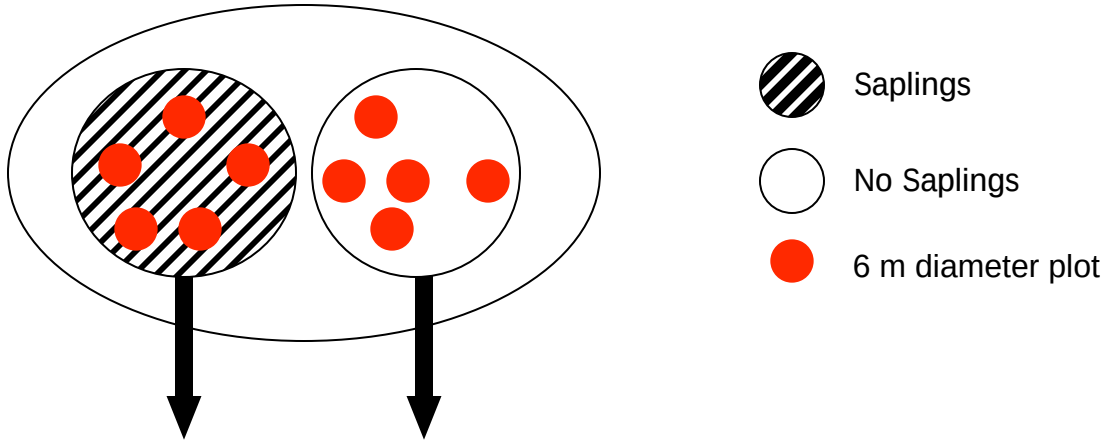
Sampled

- Herbaceous Cover

- Small Mammal Activity *Thomomys* spp., *Spermophilus beecheyi*

- Soil Moisture

# Design




Mean Recruiting - Mean Non-Recruiting = Data Point

Plot Design

- Located randomly within recruiting and non-recruiting areas

- Controlled for valley oak adult cover

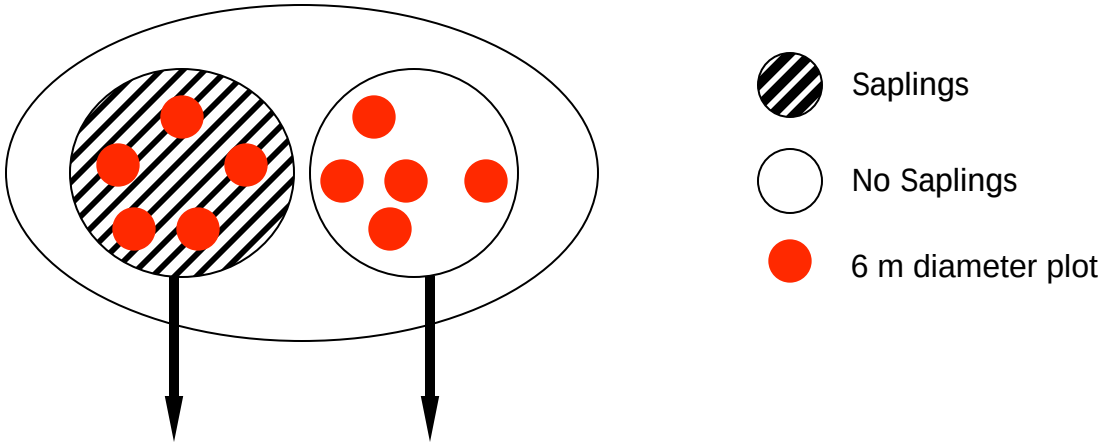
Sampled

- Herbaceous Cover

- Small Mammal Activity

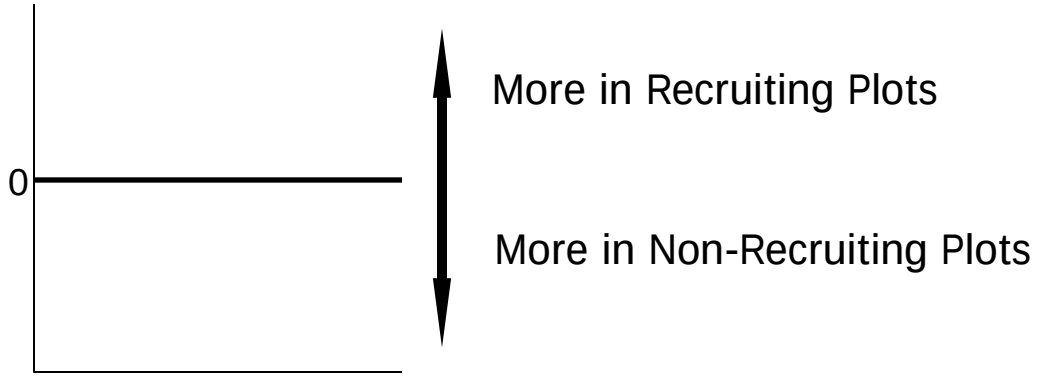
- Soil Moisture

# Design

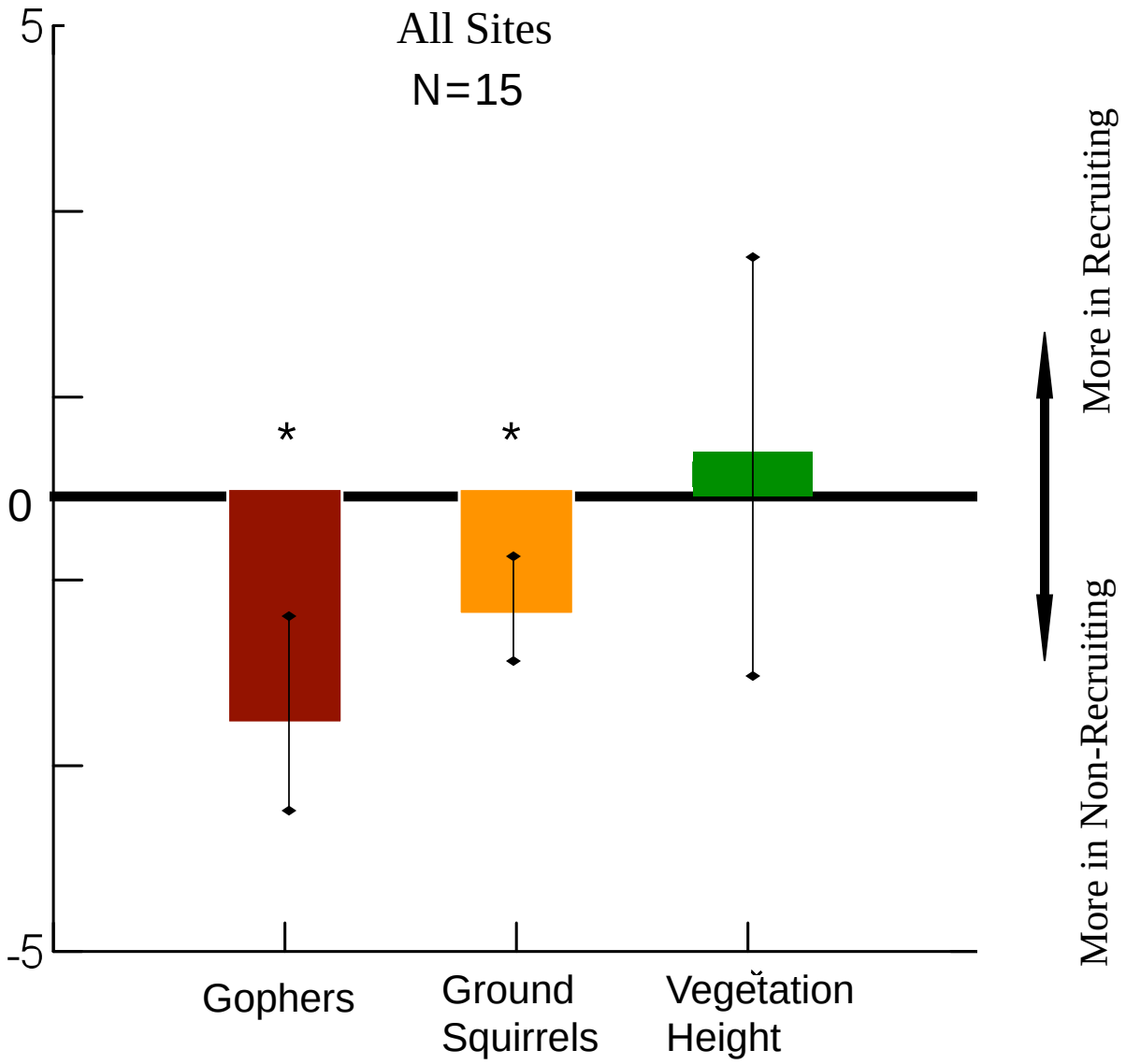



Mean Recruiting - Mean Non-Recruiting = Data Point

***Replicate = Site***

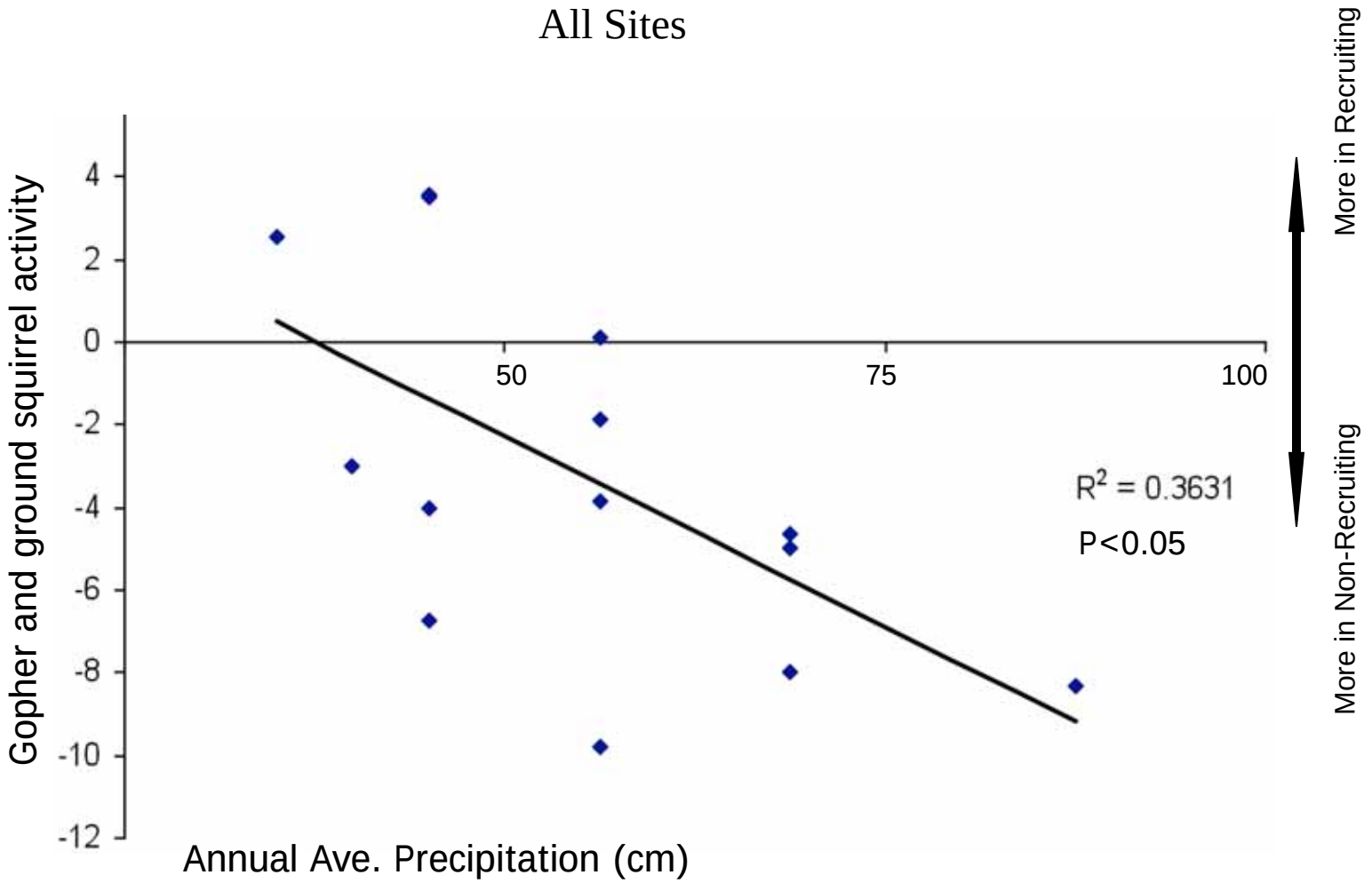


# Recruiting areas associated with lower ground squirrel and gopher activity than non-recruiting areas

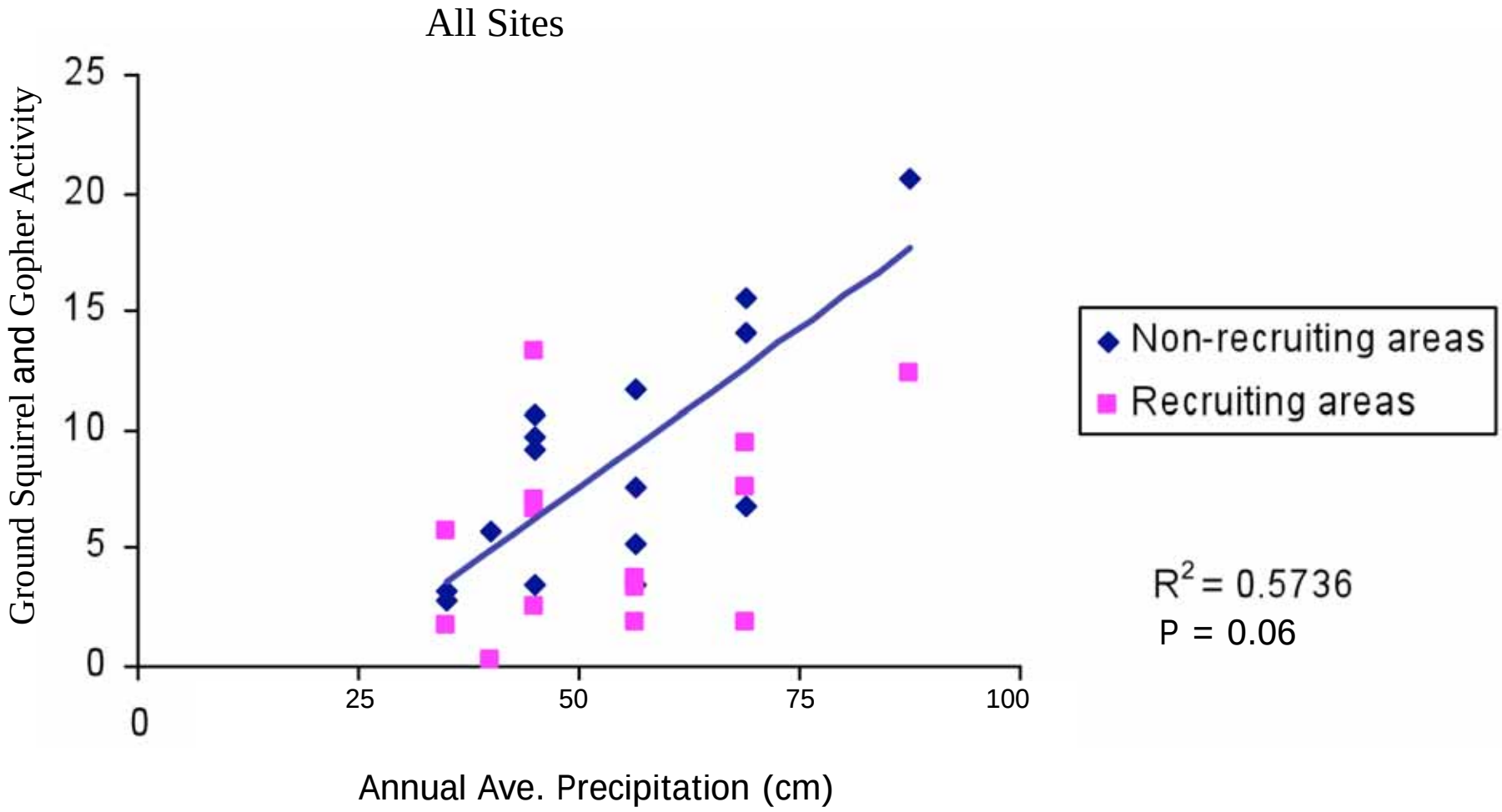



* = P<0.05

# Precipitation alters herbivore effect

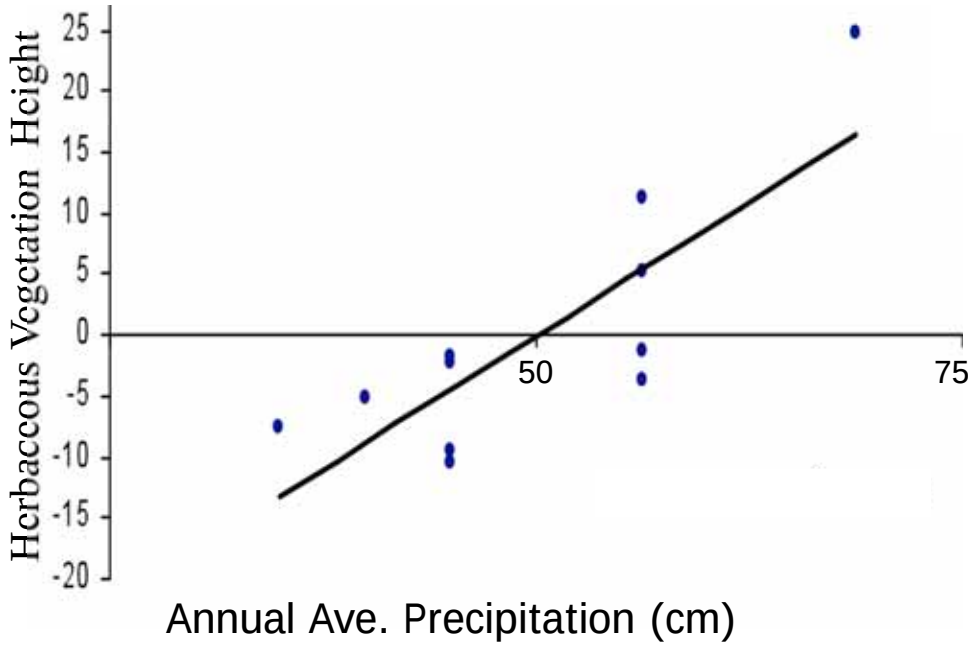


# Herbivore activity increases with precipitation



# Rainfall alters competition effect in savanna

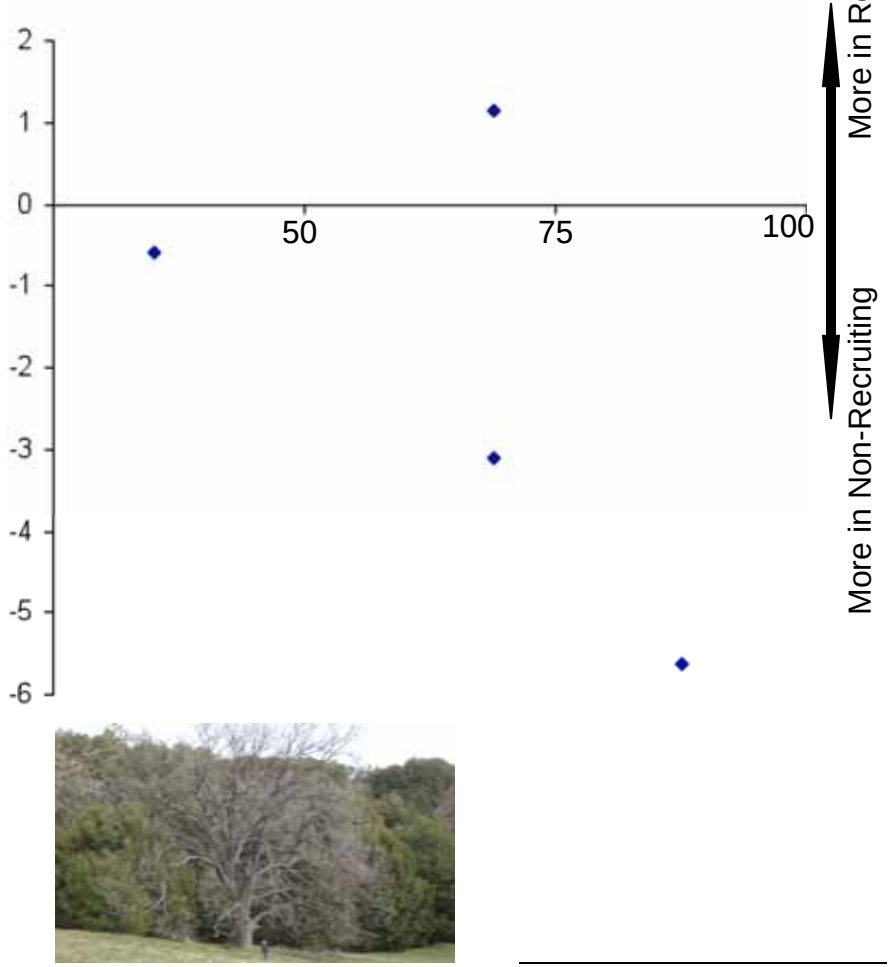
Savanna Sites




$R^2 = 0.66$

$P < 0.05$

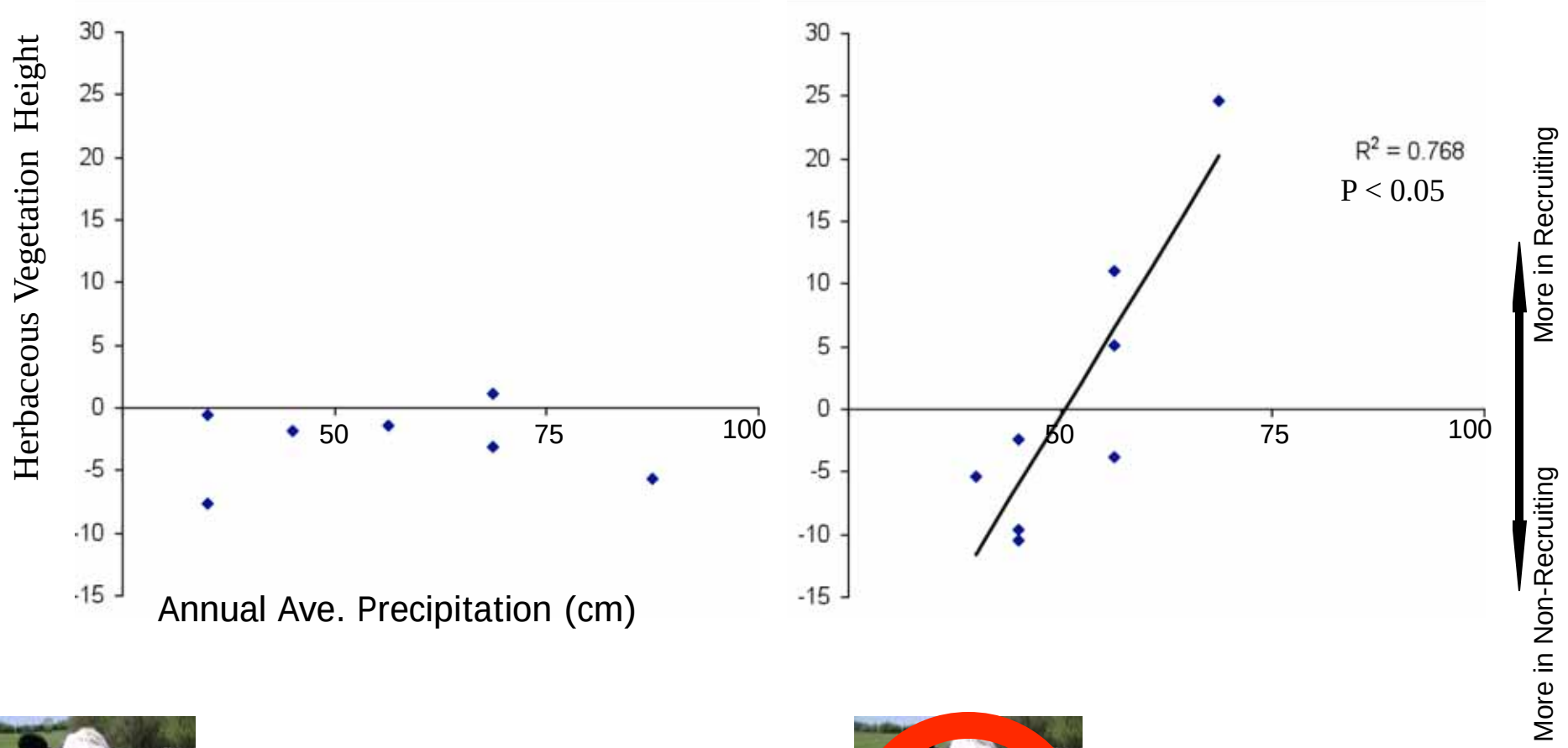
Woodland Sites



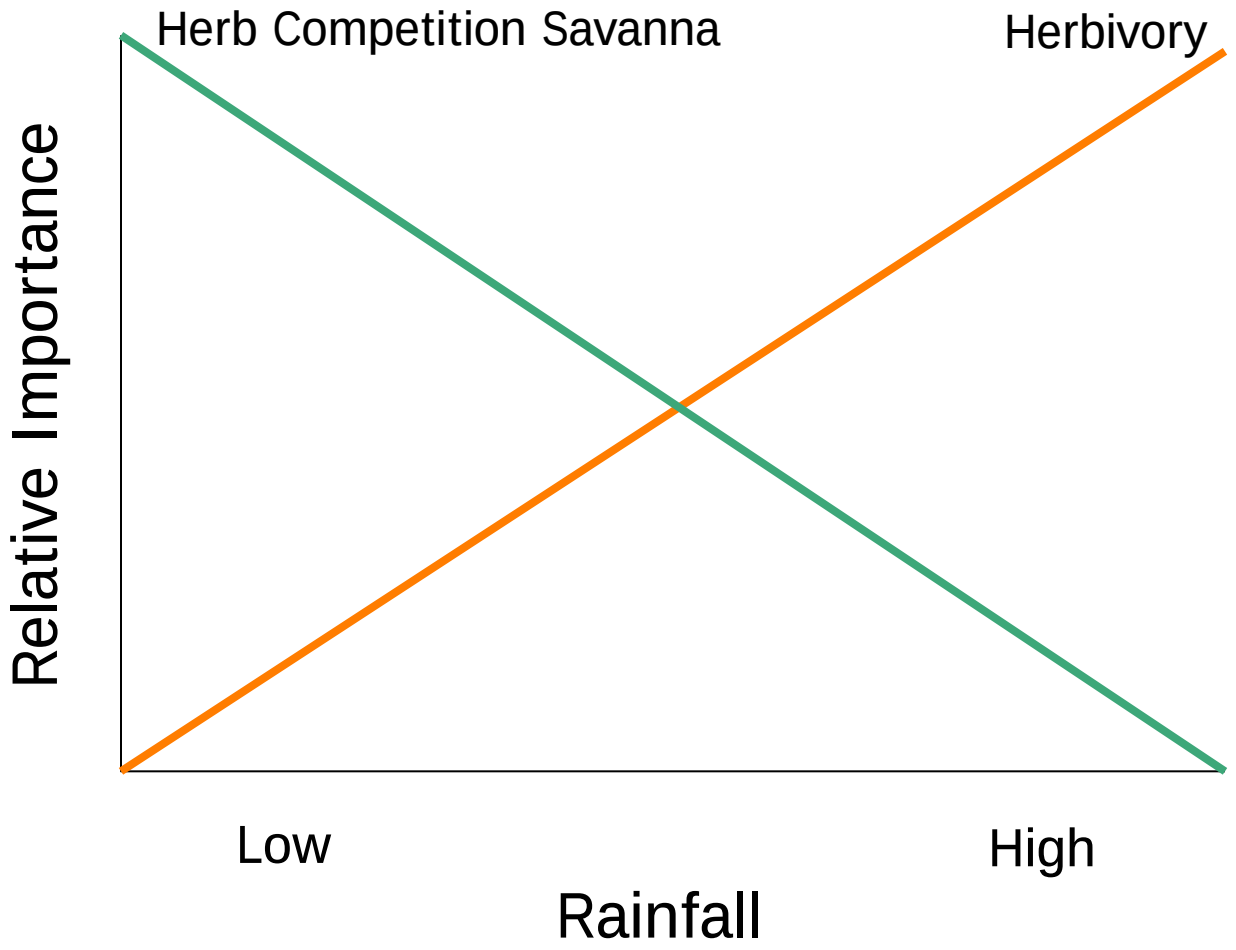
# Rainfall effect on competition depends on grazing regime

Grazed Sites

Un-grazed Sites




# Conclusions: Effects of competition and herbivores vary along a rainfall gradient



# Valley Oaks and Climate Change

- Constriction around water sources
- Strongly mediated by local ecological factors

## Special Thanks To

**The Zavaleta Lab**

**Ingrid Parker, Greg Gilbert, Margaret Fitzsimmons, Kevin Rice, Michael Loik**

**Central Coast Rangelands Coalition**

**CA Native Plants Society**

**Oak Woodland Conservation Working Group**

**Brian Emerson, Corinne Morozumi**
**Daniella Reagan, Caleb Caswell-Levy**
**Arthur Platel, Tessa Dahlen, Elise Hariton,**
**Brandy Saffel, Dustin Mulvaney**



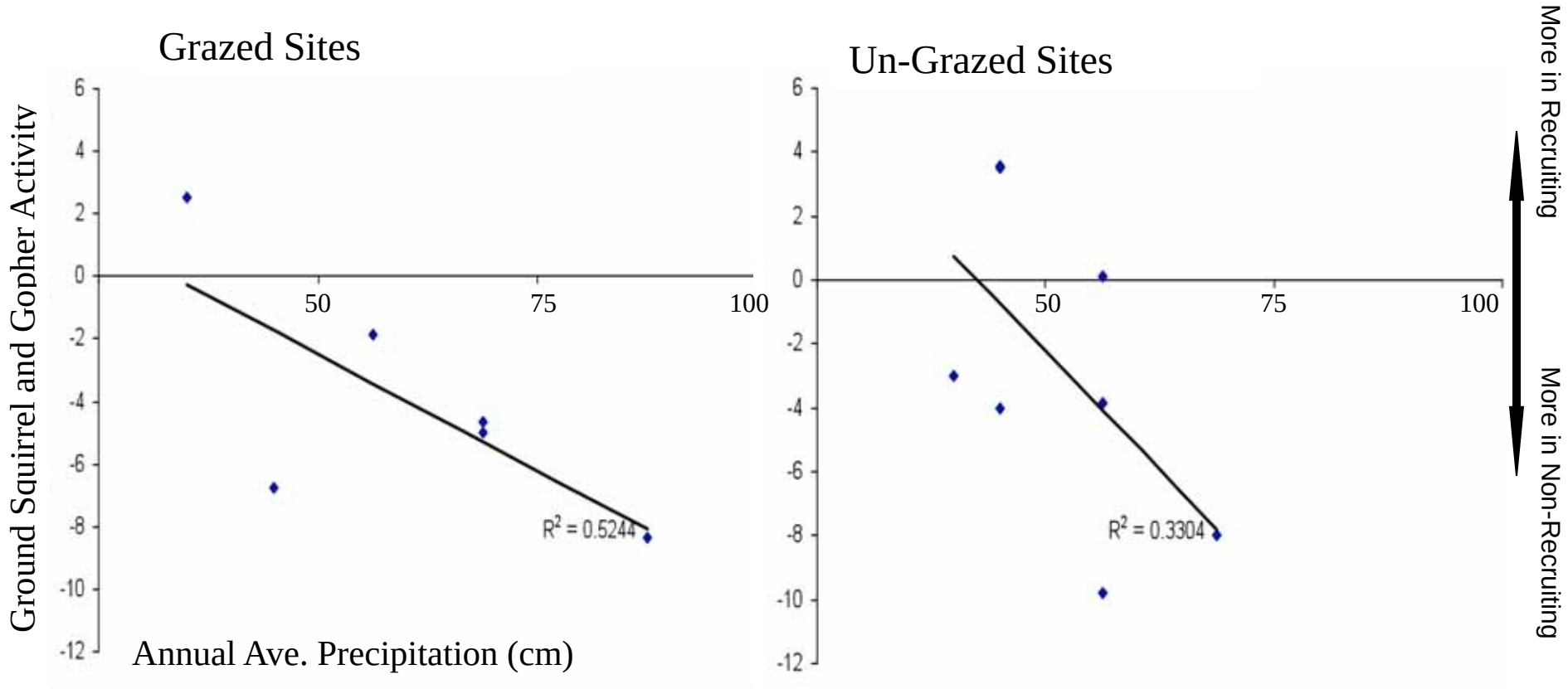
**Funding**

**CA Energy Commission (PIER); National Science Foundation; Community Forestry and Environmental Research Partnerships; STEPS; California Native Plants Society; UC Natural Reserve System: Mathias Grant; Marilyn C. Davis Scholarship**



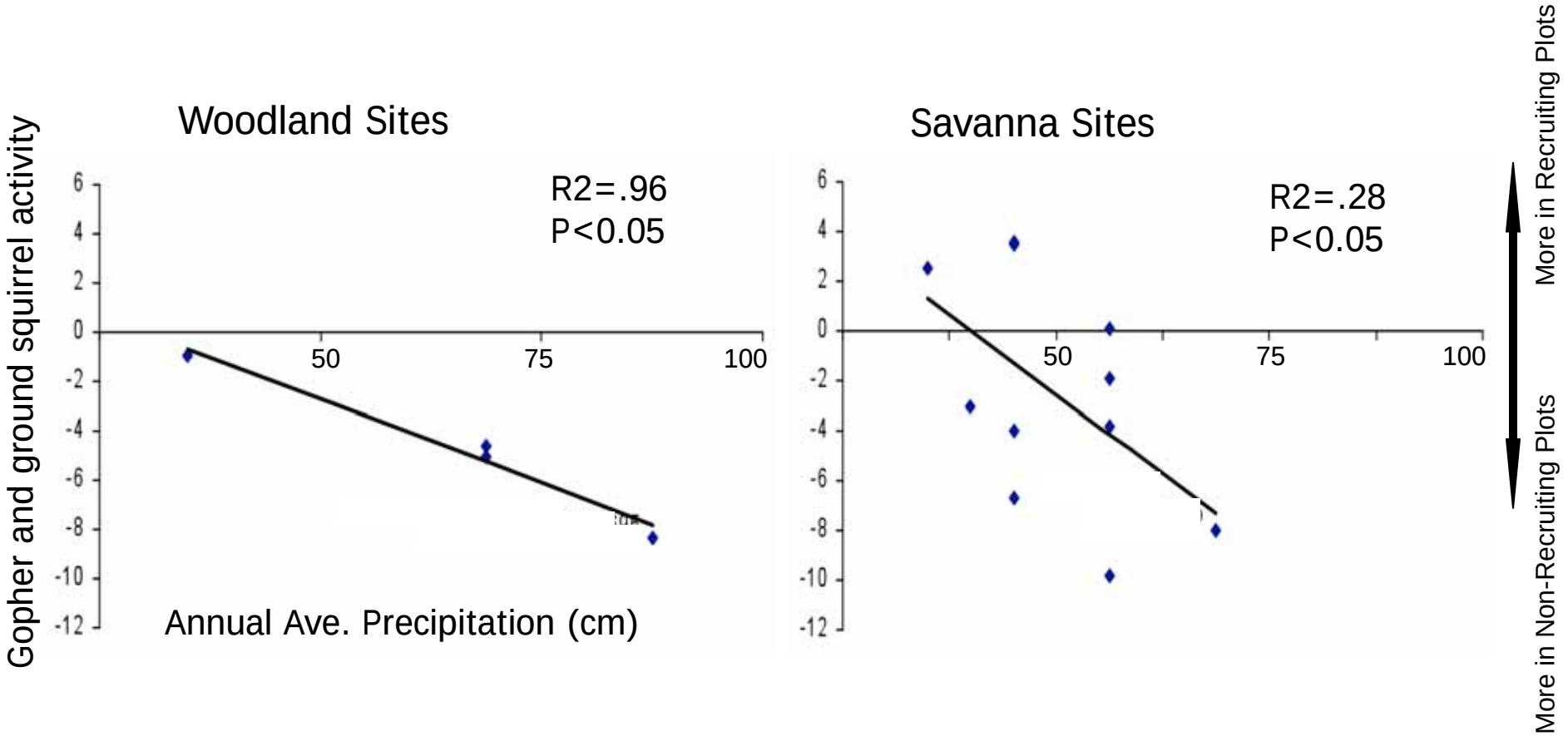
Contact:
Blair McLaughlin, bcmclaug@ucsc.edu

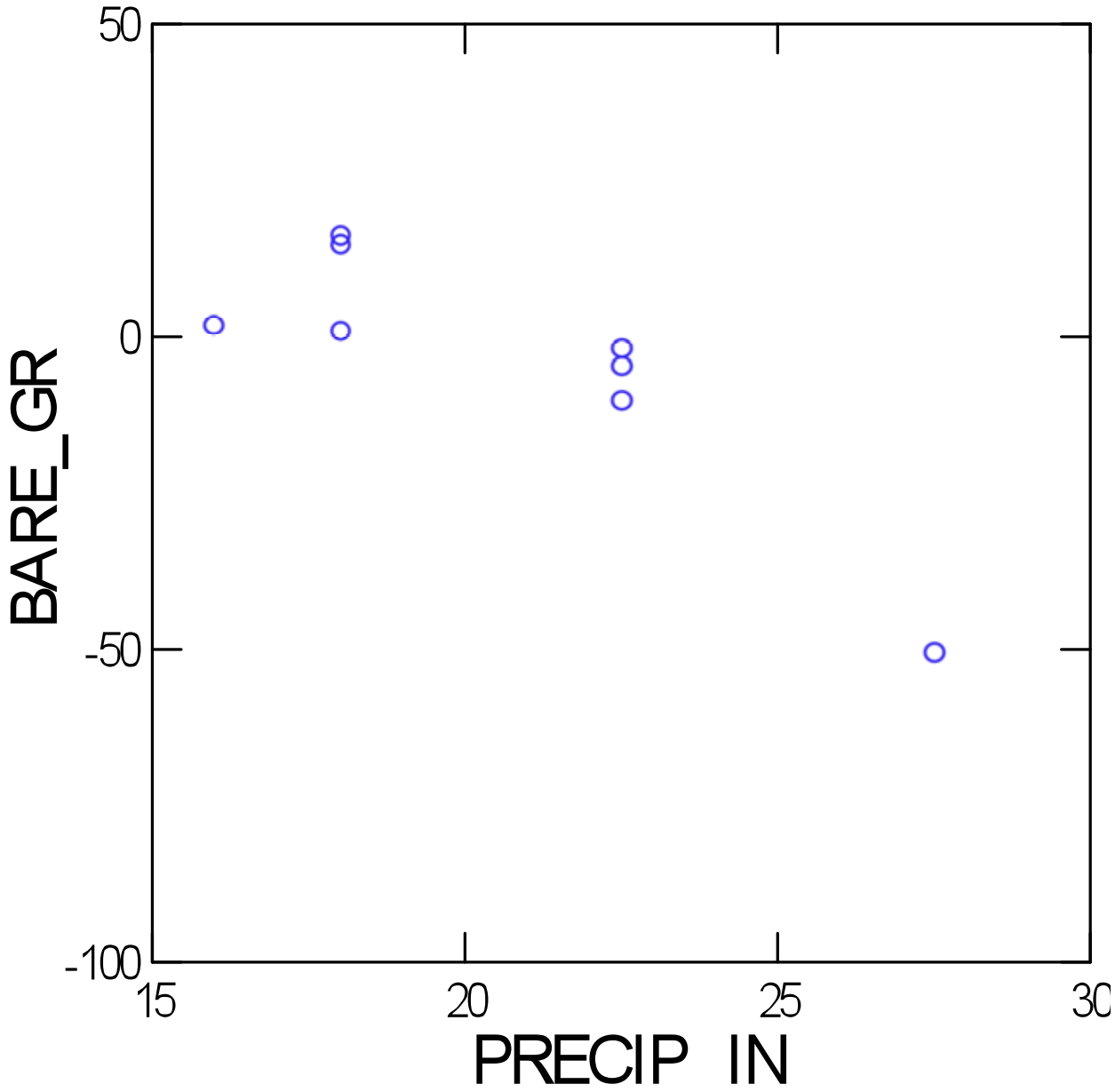
# Precipitation alters herbivore effect



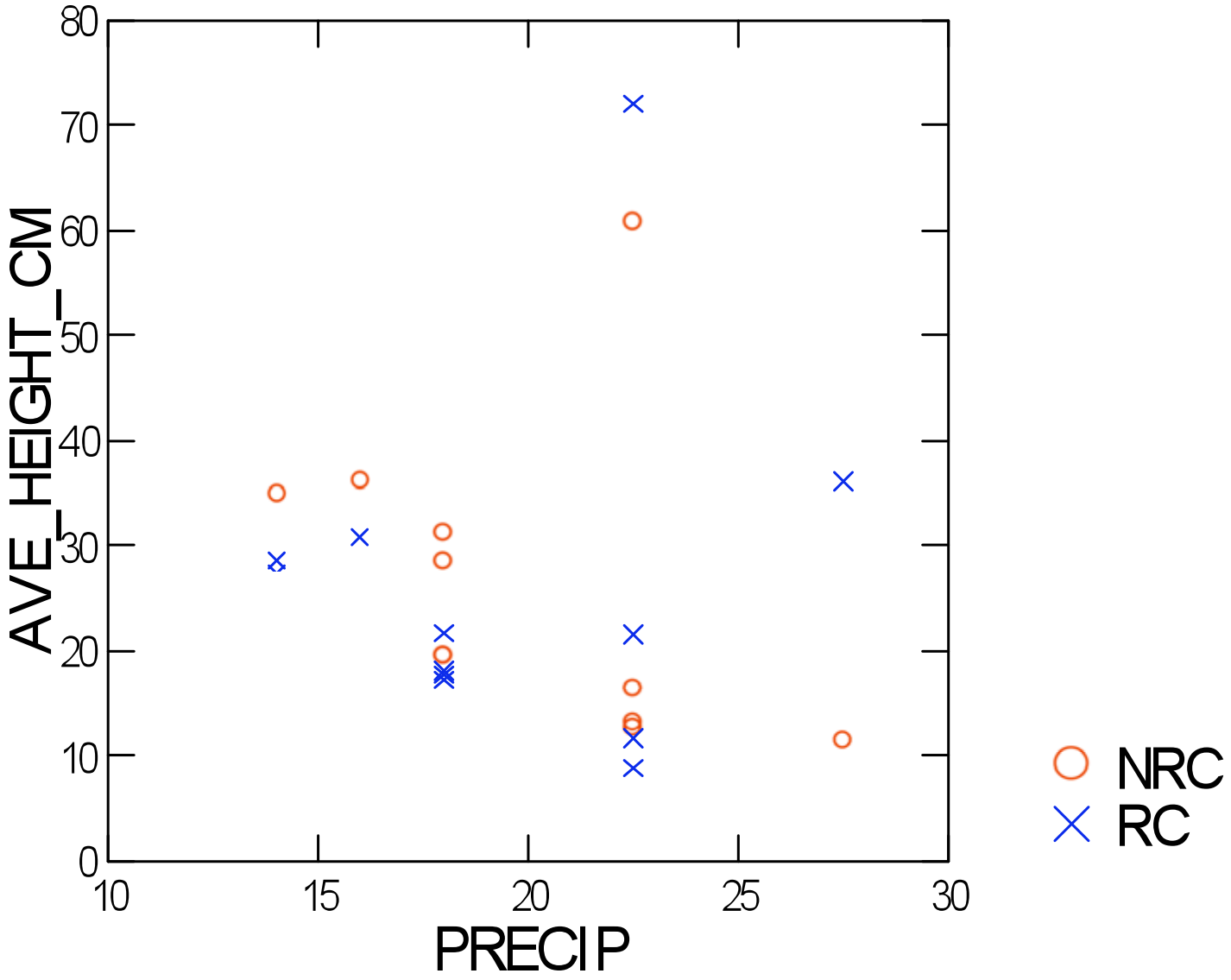

P<0.05

# Precipitation alters herbivore effect

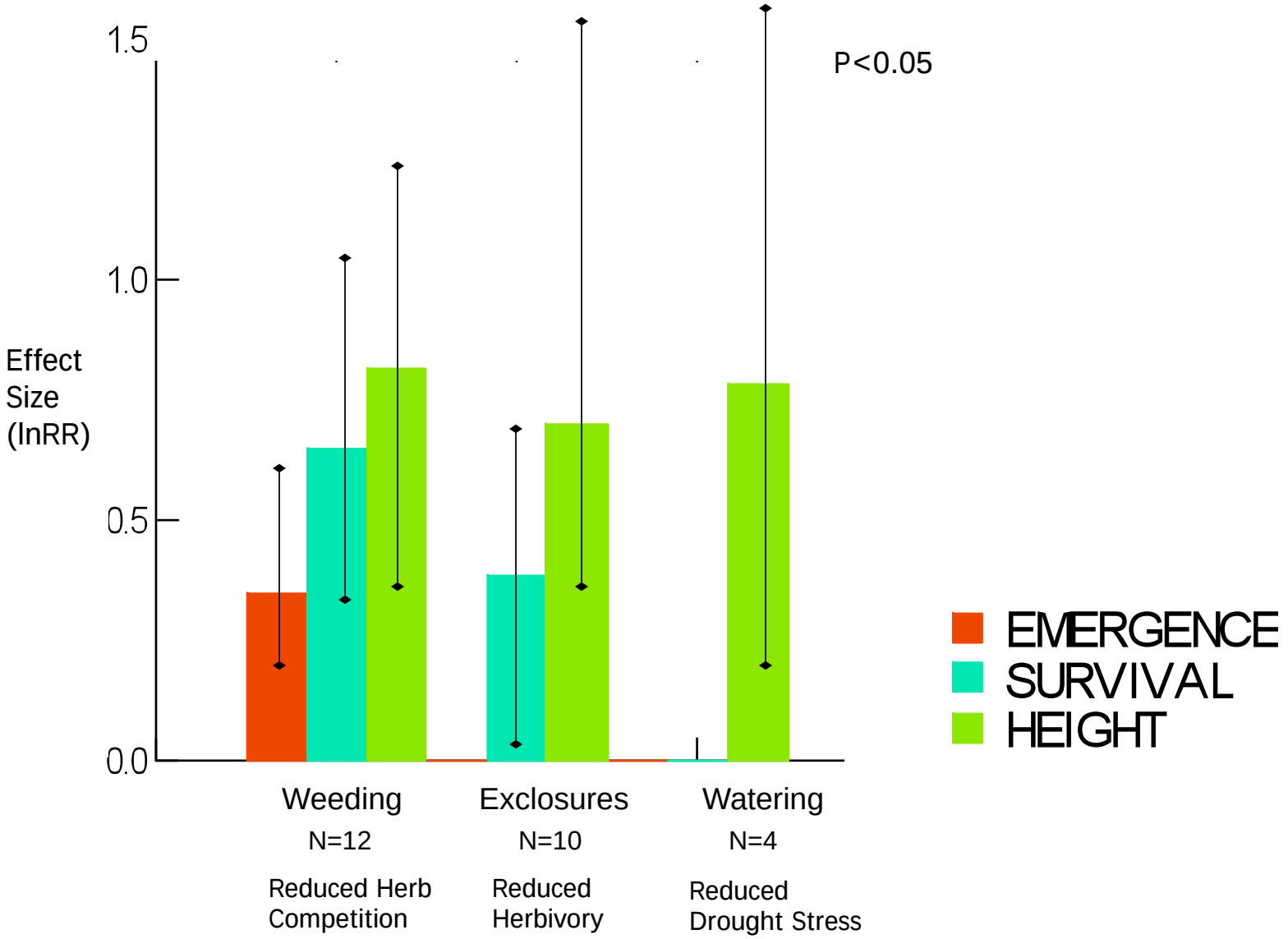


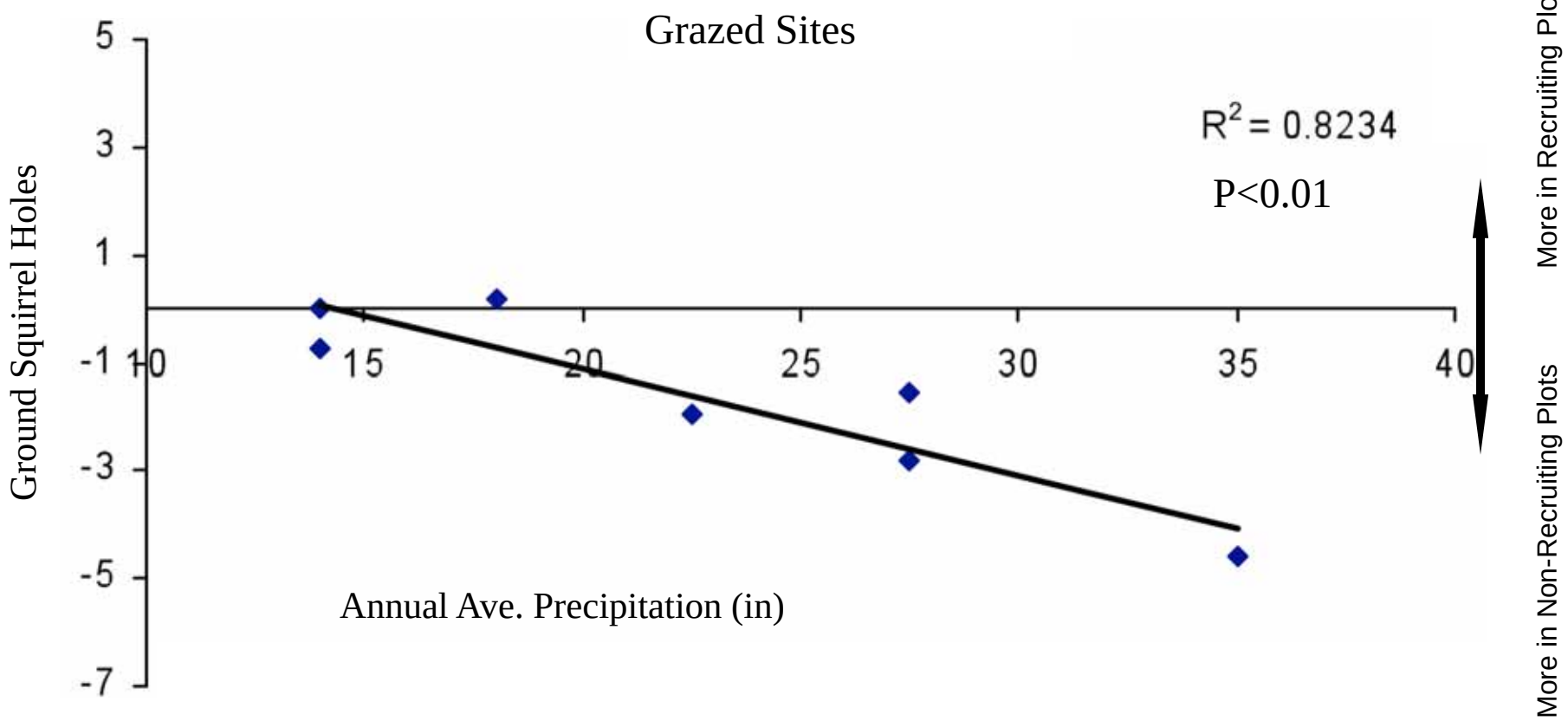

P<0.05

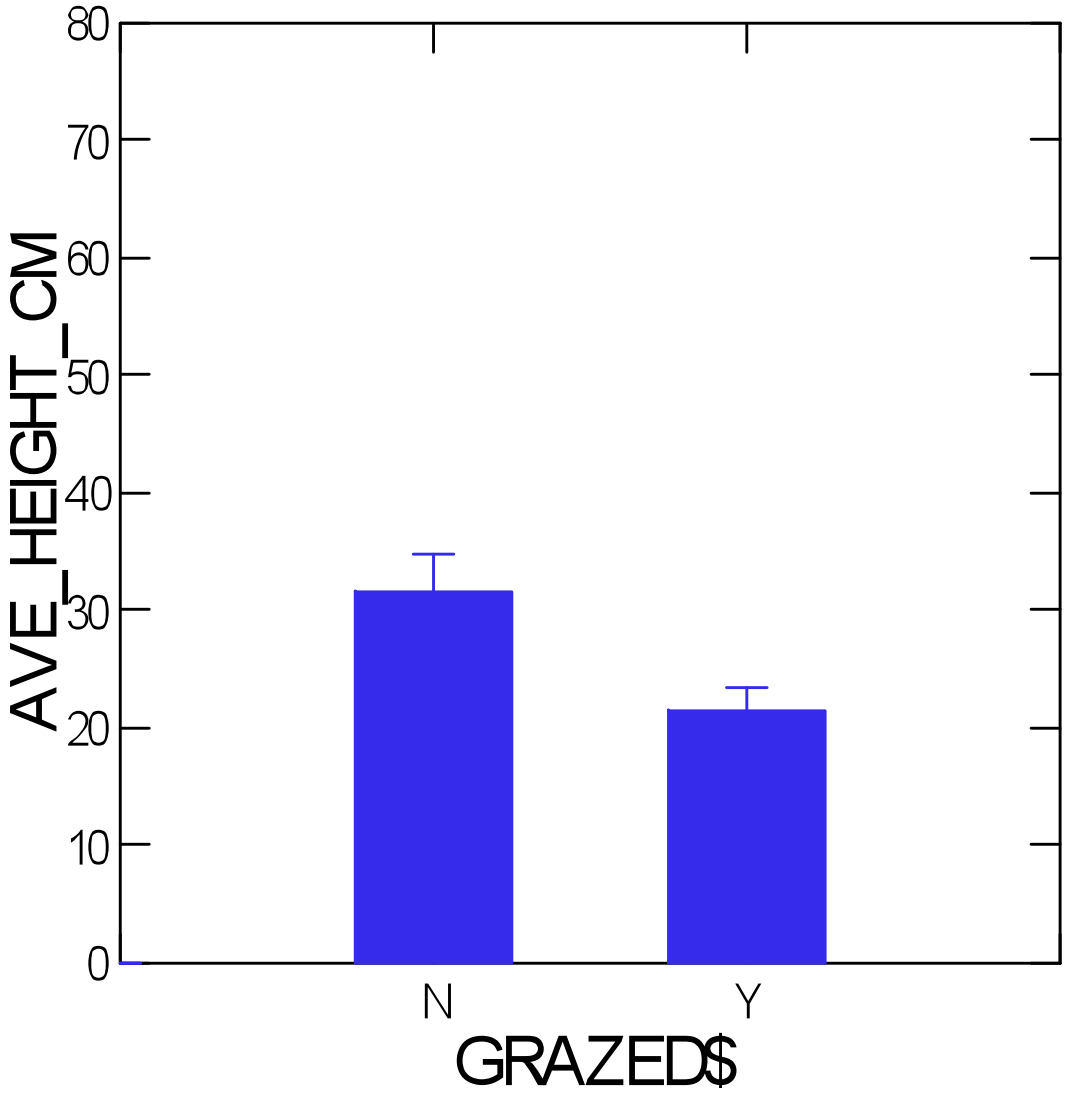

AVE_HEIGHT_CM
80
70
60
50
40
30
20
10
0
10
15
20
25
30
PRECIP
NRC
RC
RC

# Meta-Analysis of Valley Oak Planting Experiments



# As precipitation increases, ground squirrel activity in non-recruiting areas becomes higher than in recruiting areas





80
70
60
50
40
30
20
10
0
AVE_HEIGHT_CM
N
Y
GRAZED$

Mycorrhizae | Soil | Fire | N Deposition

Pathogens

Insects

Deer

Ground squirrels
Gophers

Cows

Feral
Pigs

**Herbivory**

Disturbance

Shrub/Canopy
Cover

Annual Grasses

**Competition**

Light

Nutrients

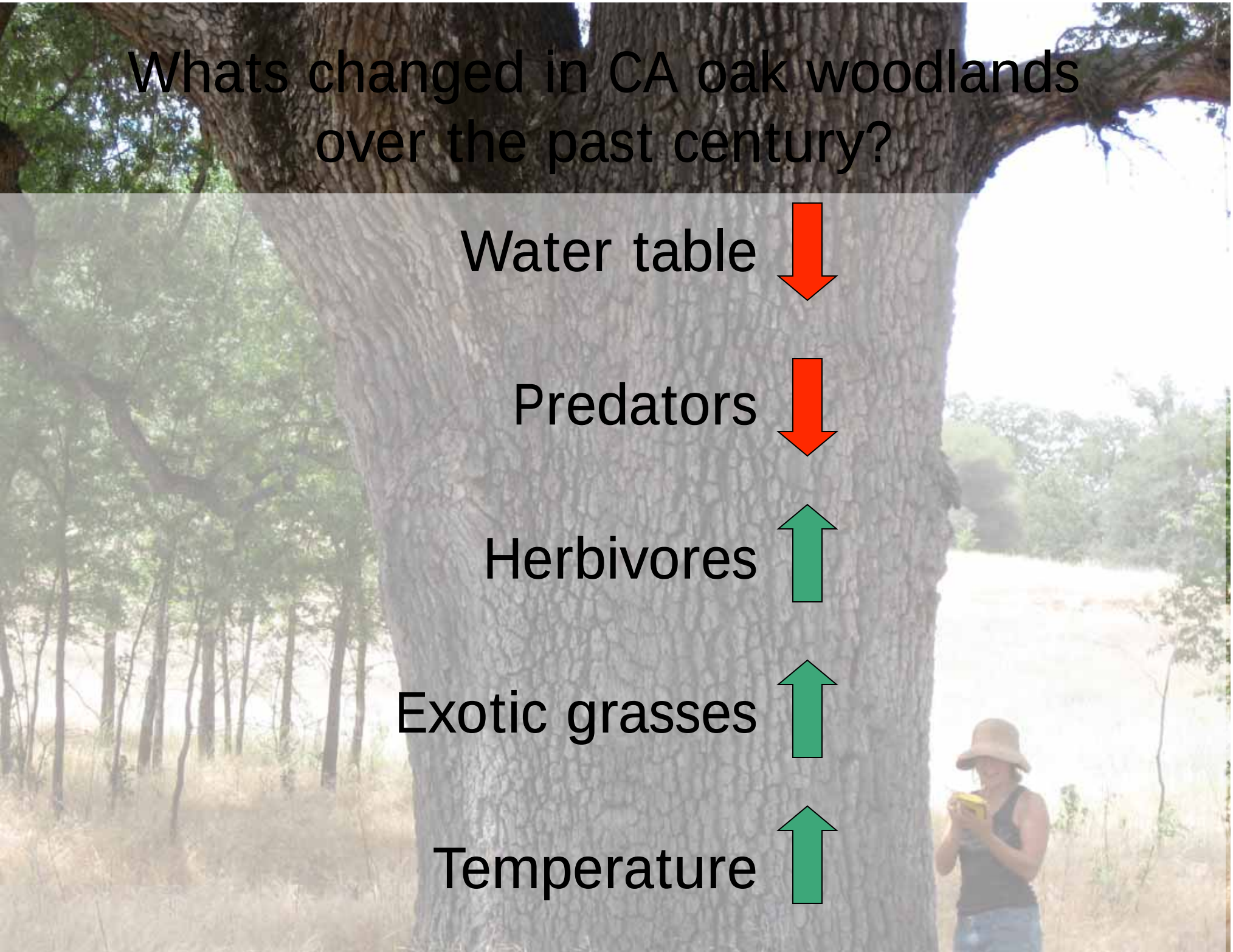
**Drought
Stress**

Microclimates

- Shade
- Streams
- Slope
- Aspect

Climate
- Rainfall
- Temperature

Ground water


Whats changed in CA oak woodlands over the past century?
Water table
Predators
Herbivores
Exotic grasses
Temperature